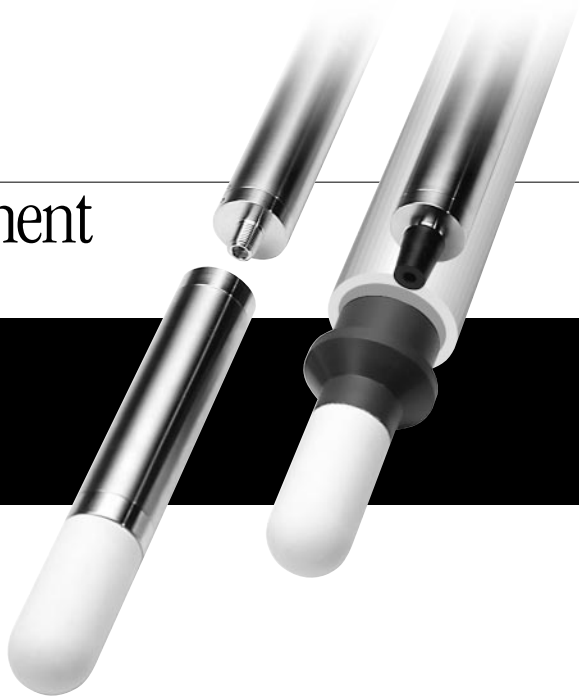
In-Situ Inc.
Helping monitor the earth's resources

Soil Water Potential Measurement

Advanced Tensiometer

Patent Pending



Soil water content is a critical factor in predicting migration of contaminants into groundwater and evaluating the stability of structures such as dams, levees, and the backfill beneath highways and buildings. The Advanced Tensiometer indicates changes in water content by measuring a related parameter: soil water potential. This type of moisture indicator is ideal for numerous geotechnical, environmental, and mining applications. In addition, when it is installed below the water table, the Advanced Tensiometer functions as a piezometer.

Conventional tensiometers have measured soil water potential in agricultural settings for more than 40 years. However, maximum installation depths of about 7 meters and low accuracy have prevented widespread use in other disciplines.

The new Advanced Tensiometer operates on the same physical principle as a conventional tensiometer and consists of (1) a porous ceramic water reservoir and (2) a pressure transducer and data logger (provided separately). Water in the reservoir moves through the porous surface until the pressure inside the reservoir equilibrates with the surrounding soil or rock. The pressure transducer measures the partial vacuum; the data logger records the measurements.

The Advanced Tensiometer features a short hanging water column, isolated from diurnal temperature changes. This stabilizes the readings compared to data from previously available tensiometers. The hanging water column also allows deeper instrument installation than previously possible.

Two types of Advanced Tensiometers are available: one for *permanent* installation and a *portable* model. The permanent model has been tested to 30 meters; the portable model to 60 meters.

Features:

- Deep installations (30 or 60 meters vs. approximately 7 meters for conventional tensiometers)
- Improved precision and stability due to protection from diurnal temperature fluctuations
- Minimal maintenance: Reservoir refilling is the only required regular maintenance; under some site conditions the interval between refills is as long as a month
- Automated data collection*
- Custom data collection schedules*
- Remote data collection via telemetry*

System Requirements:

The Advanced Tensiometer is an accessory that requires the use of either (1) a 30 PSIA non-vented TROLL 4000 logger/probe or (2) a 30 PSIA PXD-261 non-vented pressure transducer. When used with the PXD-261, a 4-20 mA data logger is also needed. In-Situ's current data loggers and logger/probes report pressure in either meters or feet of water, psi, or kPa.

Example Applications

NOTE: The Advanced Tensiometer measures soil water potential and can be used to monitor relative changes in soil moisture. The relationship between soil water potential and water content/moisture is site- and substrate-specific.

Waste Management: Monitoring of soil water potential under a landfill provides a new, economical method for evaluating landfill liner integrity. Advanced Tensiometer readings indicate soil moisture changes; these changes may be related to natural flow of water under the site or leakage from the landfill liner.

Geotechnical Engineering: Dam integrity and slope stability are affected by moisture content; the Advanced Tensiometer indicates relative changes in moisture. Its measurements also aid in assessing the effectiveness of site dewatering programs.

Mining: Movement of fluids through unsaturated materials is crucial to two aspects of many mining operations: heap

* when paired with a TROLL 4000 logger/probe or PXD-261 transducer and HERMIT data logger.

Advanced Tensiometer

leaching efficiency and tailings pile stability. An array of Advanced Tensiometers allows automated monitoring of relative changes in water content in both settings.

Water Resource Management: Soil water potential trends provide data useful in evaluating evaporation and recharge to aquifers. In addition, soil water potential trends may help in predicting whether precipitation will infiltrate the ground or flow overland–valuable information when assessing flash flooding potential.

Agriculture: Use of an Advanced Tensiometer allows evaluation of irrigation efficiency, saving water, power, and labor. Automated data recording and the ability to transmit data via radio or modem provide added convenience.

Warranty

The Advanced Tensiometer comes with a 90-day warranty.

Specifications

Permanent Model: PVC for PXD-261 (30 PSIA)

Materials:	Ceramic, PVC, Viton®, epoxy, 316 stainless steel, rubber
Dimensions:	1.4" dia., 4.6" long (3.6 x 11.7 cm)
Weight:	0.26 lb. (0.12 kg)
Operating Temperature:	5° to 30°C (41° to 86°F)
Pipe Compatibility:	1" thin-wall, 200 psi PVC
Maximum Depth:	Tested to 100 ft. (30 m)

Permanent Model: PVC for TROLL 4000 (30 PSIA)

Materials:	Ceramic, PVC, Viton®, epoxy, 316 stainless steel, rubber
Dimensions:	2.4" dia., 5.2" long (6.1 x 13.2 cm)
Weight:	0.48 lb. (0.22 kg)
Operating Temperature:	0° to 30°C (32° to 86°F)
Pipe Compatibility:	2" PVC, schedule 40 or 80
Maximum Depth:	Tested to 100 ft. (30 m)

Portable Model: Stainless Steel for TROLL 4000 (30 PSIA) or PXD-261 (30 PSIA)

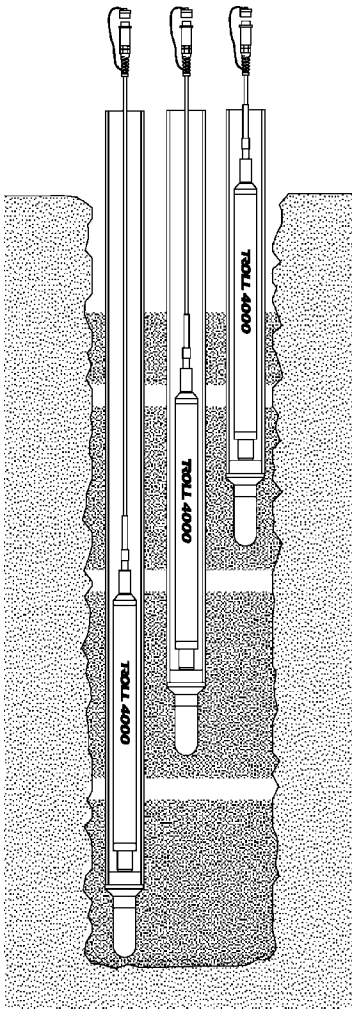
Materials:	Ceramic, 316 Stainless Steel, Viton®, epoxy
Dimensions:	1.4" dia., 8.8" long (3.6 x 22.4 cm)
Weight:	1.2 lb. (0.55 kg)
Operating Temperature:	0° to 30°C (32° to 86°F) (TROLL) 5° to 30°C (41° to 86°F) (PXD)
Pipe Compatibility:	2" PVC, schedule 40 or 80
Maximum Depth:	Tested to 200 ft. (60 m)

Ceramic Cup Specifications

Materials:	56% SiO_2, 15% Al_2O_3, 12% MgO, small amounts of other elements
Hydraulic Conductivity:	3.46 x10^{-7} cm/sec
Air Entry Value/ Bubbling Pressure:	1 bar (1,000 cm)

Viton is a registered trademark of E.I. DuPont de Nemours Company.

Example installation: Borehole with three Permanent PVC Advanced Tensiometers installed at different depths to monitor leakage under a waste site. Bentonite layers seal against water transmission down the casings.



Due to continuing product development this information is subject to change without notice.

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